On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 4, line 14 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

Referring to FIG. 1e, there is shown another guide tube 32 described in Canadian Patent 886,174 issued to Norcross and titled Electroslag Welding Nozzle and Process. The Norcross '174 patent describes an upwardly extending stationary consumable metallic nozzle having a metallic guide tube through which a single welding wire is introduced. The consumable metallic nozzle has wing bars extending out on two sides of the guide tube and an adhering coating of flux covering the nozzle, which melts off as the weld rises, and as the nozzle itself melts off. In an electroslag process using a narrow welding gap, i.e. NGI-ESW, the thin layer of flux used by Norcross would generate an arc between the guide tube electrode and the substrate or welding shoes. Furthermore, it the thick plates used by Norcross would draw too much amperage.

A1

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 21, line 12 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A2-

FIG. 5 is alternative embodiments of guide tube designs with flat strips and formed thin strips. Guide tube 260 comprises a thin strip 262 that is formed to define two 90° elbow at the edges of the thin strip; the elbows provide an opening for welding wires 264 and 266. Guide tube 270 comprises a thin strip 272 that is formed with rounded edges; the rounded edges provide an opening for welding wires 274 and 276. Guide tube 180 comprises two thin strips 282 and 284 which are formed with one 90° elbow at the edges of each thin strip and providing an opening for welding wires 286 and 288. Guide tube 290 comprises two flat strips 291 and 292 joined to two thin strips 293 and 294 and providing an opening for welding wires 296, 297 and 298. Guide tube 300 comprises a thin strip 302 which has one 90° elbow at each edge and has a depression in the center of the thin strip 302 that is adjacent the flat strip 304; the depression and elbows provide an opening for welding wires 306 and 308.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 26, line 8 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A3

FIG. 9 is a method 480 for manufacturing the guide tube. The preferable method 480 for manufacturing the guide tube is engaged at block 482 in which a first metal strip is selected. The first metal strip is preferably a low carbon cold-rolled steel strip. At block 484, the second strip material is selected, and the second strip is preferably a low carbon hot rolled steel strip. Alternatively, the first metal strip and second metal strip can be made of a low carbon steel or medium carbon steel. Additionally, the first metal strip and the second metal strip can be cold rolled steel or hot rolled steel. It shall be appreciated by those of ordinary skill in the art that other types of steel having similar properties may also be used. The low carbon hot-rolled steel strip is used as the current carrying side of the guide tube, and is therefore, thicker than the first metal strip. Alternatively, the first metal strip and the second metal strip are the same thickness. The method then proceeds to block 486.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 14, line 13, line 14 and line 16 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A4

In operation, the guide tube 228 feeds at least two welding wires 235 and 238 into the molten slag bath. The guide tube 228 and welding wires 235 and 238 act as an electrode which transmit the necessary power or amperage to maintain a molten slag bath. The welding wires 235 and 238 perform the function of feeding more mass into the weld puddle; this additional mass acts as a heat sink for the molten weld puddle and maintains a relatively shallow weld puddle.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 18, line 16, for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

AS

Adding at least two wire feeds in the present process decreases dilution of the parent material and does not dilute the nickel concentration. In the ARCMATIC process, at least two wires are used to weld the material. Even for one-inch strip, the novel electroslag process uses two wires. The reason is for any give amperage you are feeding more mass into the strip by doubling the amount of mass of welding wires. This additional mass acts as a heat sink, which effectively "dries" up the molten weld puddle and maintains a shallow puddle depth. The shallower puddle depth maintains a higher form factor, which is more crack-resistant. The benefit of using more feed wires is that it keeps the puddle shallow and more crack-resistant.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 9, line 10, for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A1

FIG. 2b is a cross-section of FIG. 2a.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 10, line 21, for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A)

The present guide tube design provides a solution which minimizes the cost of a consumable guide tube for welding and maximizes the quality of the surrounding weld. The application of the consumable guide tube disclosed herein is based on electroslag welding methods. In particular the guide tube described herein is employed in an oscillating electroslag welding process which is described in patent application 09/058,741 now U.S. Patent 6,297,472 titled "Welding System and Method" which is hereby incorporated by reference. However, it shall be appreciated by those skilled in the art having the benefit of this disclosure that the principles of guide tube design described in this patent may also be applied to other welding methods.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 11, line 21 and 22, and on Page 12, line 5 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A8

During experimental efforts undertaken by the inventor, a guide tube having two 4-inch wide metal strips which were each 1/4-inch thick was subjected to the electrical loading for electroslag welding. The cross-sectional area of the guide tube was 2 inches^2. The load was so great on the 2 inches^2 guide tube that when the guide tube made contact with the slag puddle the amperage of the power supply could not be reduced below 2500-Amps. To solve this problem the plates were made thinner. For a 4-inch wide weld, the preferred guide tube design included a current carrying plate being 1/8" think fixedly coupled to a wire guide plate having a 22-guage material. It shall be appreciated that the 22-guage plate equivalent is a 0.025" plate. The cross-sectional area of the preferred guide tube for a 4-inch weld was 0.6 inches^2.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 12, line 9 and line 13 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A9

By way of example and not of limitation, if a weld which was 8-inch wide is undertaken, then the guide tube dimensions for a 4-inch weld draw too high a load because the cross-sectional area would be too high, e.g. 1.2 inches^2. To adequately bring down the amperage, the cross-sectional area for a guide tube making an 8-inch weld would be reduced to having a current carrying strip of 1/16" thick, and a wire guide strip being made of a 22-guage material. Therefore, the cross-sectional area of the preferred guide tube for an 8-in weld was 0.7 inches^2.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 12, line 18 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A10

An illustrative example of this guide tube design is provided in FIG. 2a and FIG. 2b which show that a similar cross-sectional area can be generated by varying the width and thickness of the flat strip. By way of example, a 1 inch wide strip which is 3/16 inch thick has a cross-sectional area of 0.1875 inches^2. The same cross sectional area can be achieved with a 2 inch wide strip which is 3/32 inch thick. Additionally, the same cross-sectional are can be obtained for a 3 inch wide strip having a 1/16 inch thick strip. Note, that in this approximation, the thin roll formed strip contribution to the cross-sectional area is assumed to be negligible. The benefit of this design is that by maintaining the same cross-sectional area the load drawn by each of guide tube is more easily controlled as described above.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 13, line 18 and line 19 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A11

FIG. 2b is a cross-sectional view of FIG. 2a. The thin strip 136 is roll formed into two triangular wedges which receive the welding wires 132 and 134. The insulating modules 138 and 140 are attached to the back of thin strip 136 at the triangular wedge positions. By way of example and not of limitation the a guide tube shown in FIG. 2a and FIG. 2b is made of one flat strip having a variable thickness from 1/16th to 1/4th of an inch and the thin roll formed strip has a thickness ranging from 22 to 28 AWG.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 17, line 13 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A12

In operation, flux deposition must be regulated carefully. Recall that flux is converted to a molten slag, and the molten slag bath acts as a floating molten resistor which is heated by resisting to the flow of current – just like the nichrome wire in your toaster is heated by resisting the flow of current. If the slag bath becomes too deep the molten slag bath dissipates heat over a larger surface of the substrate. This larger surface cools the molten flux bath and the flux puddle becomes colder. If the slag bath temperature becomes too low, the molten slag will not melt the wire as efficiently. This can cause incomplete penetration of the weld metal to the substrate, resulting in a defective weld. If the molten flux puddle becomes to shallow, the puddle is not required to head as much surface area of the substrate, this causes the puddle to become very hot. This rise in flux puddle temperature can cause the guide tube to burn off above the flux puddle, inducing arcing between the electrode and the substrate or the weld puddle. As shown in FIG.3 when the insulator modules 230 and 232 are melted, they contribute very little volume to the molten flux puddle . Insulator modules 230 and 232 are spaced at intervals, which contribute to the molten slag bath at a rate which is less than the rate at which the molten slag is lost from plating against the copper shoes 224 and 226. If the molten slag in the weld cavity becomes too low, an operator can hear the slag bath "popping" and can simply add manually additional flux. If automatic flux dispensing is used, the electronic control senses the current and voltages swings generated by a shallow puddle. The controller automatically adds flux to the puddle until the current and voltage swings are reduced to an acceptable level. This method will maintain the flux at a relatively constant level.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 19, line 4 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

FIG. 3b is an isometric view of a butt weld fixture for electroslag welding 240 having a single wire consumable guide tube 242 disposed within a gap defined by two substrates and two copper shoes. More particularly, the single wire guide tube 242 is made from two separate strips of low-carbon hot rolled steel. The first steel strip 243a is flat, and the second steel strip 243b has one longitudinal channel rolled into the surface of the strip. The first steel strip 243a is placed on the second steel strip 243b and the one longitudinal channel provides a 1/8" diameter cavity which receives a 3/32" diameter welding wire. The strips 243a and 243b are spot welded to make the single wire consumable guide tube 242.

AB

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 21, line 15 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

P14

FIG. 5 is alternative embodiments of guide tube designs with flat strips and formed thin strips. Guide tube 260 comprises a thin strip that is formed to define two 90° elbow at the edges of the thin strip; the elbows provide an opening for welding wires 264 and 266. Guide tube 270 comprises a thin strip 272 that is formed with rounded edges; the rounded edges provide an opening for welding wires 274 and 276. Guide tube 280 comprises two thin strips 282 and 284 which are formed with one 90° elbow at the edges of each thin strip and providing an opening for welding wires 286 and 288. Guide tube 290 comprises two flat strips 291 and 292 joined to two thin strips 293 and 294 and providing an opening for welding wires 296, 297 and 298. Guide tube 300 comprises a thin strip 302 which has one 90° elbow at each edge and has a depression in the center of the thin strip 302 that is adjacent the flat strip 304; the depression and elbows provide an opening for welding wires 306 and 308.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 23, line 14 and 15 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A15

FIG. 6c is a front view of two single strips which are joined or sandwiched together. The front view of apparatus 350 is of the back face of a second strip 351 having milled longitudinal channels 352 and 354 on the front face and two insulator modules 356 to 358 on the back face. The second strip is joined to the first strip by resistance spot welding at locations 360, 362, 364 and 366. Those skilled in the art that other techniques for joining the first strip to the second strip include tack welding the sides of both strips, or using an adhesive to join both strips, shall appreciate it

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 24, line 16 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A!b

FIG. 7b is a cross-sectional view of a guide tube having insulator modules on the front , back and the two sides of the joined strips. The guide tube 380 has milled or roll-formed longitudinal channels which receive wires 382 and 384. The insulator modules include modules 386 and 388, which are attached to the front and back face of each strip; and insulator modules 390 and 392 which are attached to the side of the guide tube.

On the following page there is a CLEAN version of the replacement paragraph for the amendment to the Specification located on Page 24, line 16 for Patent Application 09/757,738 and in response to the Action dated 10/04/2002. This amendment complies with 37 CFR 1.121(b)(1)(ii).

A17

FIG. 7c is a cross-sectional view of an alternative embodiment in which three strips are joined together. Guide tube 400 comprises three strips. The first strip 402 is a flat metal strip. The second strip 404 and third strip 406 each have longitudinal channels. The second strip 404 and third strip 406 is coupled to the first strip 402. The second strip 404 coupled to the first strip 402 defines an opening through which wire 408 is received. The third strip 406 coupled to the first strip 402 through which wire 410 is received. Insulator modules 412 and 414 are positioned on the edges or sides of the guide tube.